Ornis Hungarica 3:7-12. 1993

Social dominance in the resident part of a Great Tit (Parus major) population in winter

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Báldi, A. and Csörgő, T. 1993. Social dominance in the resident part of a Great Tit (*Parus major*) population in winter. – Ornis Hung. 3: 7-12.

Social dominance and mortality was studied in wintering Great Tits in a Central-European alder forest. We carried out nocturnal checkings to determine residency of tits. Roosting boxes are assumed to be an essential part of the resources, therefore that sex and age class, which can occupy the boxes for longer time is dominant over the others. The dominance order is as follows: adult male, adult female, immature male and immature female in descending order of dominance.

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1. Introduction

Winter survival of the temperate-zone *Parus* species may depend on the ability to hold roosting cavities. Cavities are assumed to be an essential part of the resources, because they provide protection against inclement winter weather and predators (Drent 1987, Bakken 1990). However, the number of cavities are limited. As the social dominance in birds may depend on the resource holding power (Maynard-Smith 1982), that species, sex or age class which can hold the cavities for a longer time can be assumed to be dominant over the others.

This study was made to investigate the within species dominance relations of resident wintering Great Tits (*Parus major*) in an Alder wood in Central Hungary, based on the ability of birds to hold a roost hole. That sex/age class was considered to be dominant over the others, where the relative abundance of individuals increase, that is which class can hold this part of the resource for a longer time.

2. Study area and methods

The study was conducted in the Ócsa swamp region in Central Hungary (47°15'N, 19°15'E). The study area was a small (7 ha) woodlot of alder (*Alnus glutinosa*), surrounded by bushes and reeds, therefore we can assume that the number of natural holes are negligible. Hundred nestboxes were put into the patch in the beginning of 1986.

To avoid the consequences of the resident – floater dichotomy on dominance, we studied only the resident part of the population. For this goal we carried out nocturnal checking, which is an appropriate method to distinguish the stable part of the population (Schmidt et al. 1985, Báldi & Csörgő 1991). The number of recaptures was used as a measure of residency. Ranking order was given to age- and sex classes according to their

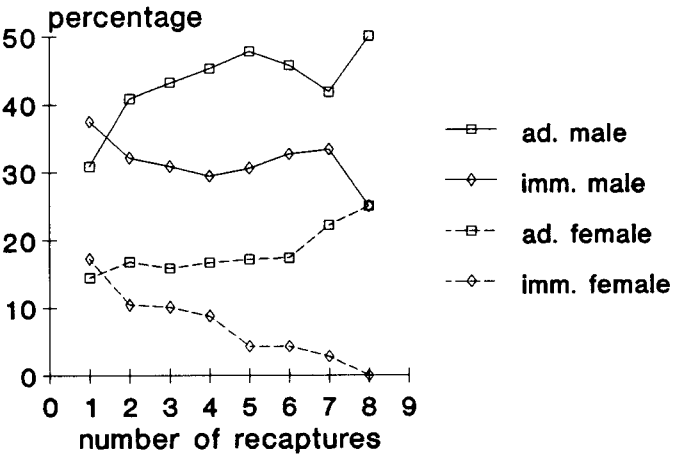

Fig. 1: Changes in composition of resident population of Great Tits based on the number of recaptures of individuals in winter nocturnal checkings (total number of individuals = 255). The values on the horizontal axis reveal to eight 'sub-populations' where all individuals were recaptured at least once, twice etc. The horizontal axis (1-8) can interpret as a scale for increasing residency.

residency. The nestboxes were checked every fortnight after nightfall to record roosting tits. Near to the nestbox area tits were captured by mistnets at a bird feeding station to collect sample from the total (resident and floater) population. The survey went on from December to March in winters from 1986/87 to 1989/90. Data from the winter of 1987/88 were excluded because of a sudden disease, which decimated the roosting population of tits (Báldi & Csörgő 1992). Data from the other three winters have been pooled.

3. Results

Three species were recorded to roost in the nestboxes. The great majority of roosting birds were Great Tits, there were altogether 693 records of 255 individuals. Blue Tits (*Parus caeruleus*) and Tree Sparrows (*Passer montanus*) were recorded rarely, altogether 22 and 11 records, respectively. The number of records of resident Great Tits were extremely high, from the total 693 records 675 belonged to already ringed individuals in the nestboxes or at the feeding station. The number of recaptures in the Blue Tit and Tree Sparrow were 16 and 1, respectively. As we pointed out in the introduction, that sex and age class of the resident Great Tits, which can occupy the nestboxes for a longer time is dominant over the others (Fig. 1). The

Tab. 1: Equations of the fitted lines on the curves of Fig. 1. The slope of the lines can interpret as a measure of dominance, because they indicate the ability to roost in nestboxes for longer time. (Multiple stepwise regression analysis, independent variable: time, dependent variables: age and sex classes. Regression coefficient, Y-intercept and p are given.)

	Regr. coeff.	Intercept	p
adult males	1.78	35.14	0.0341
adult females	1.26	12.56	0.0047
immature males	-0.89	35.43	0.1057
immature females	-2.15	16.95	0.0001

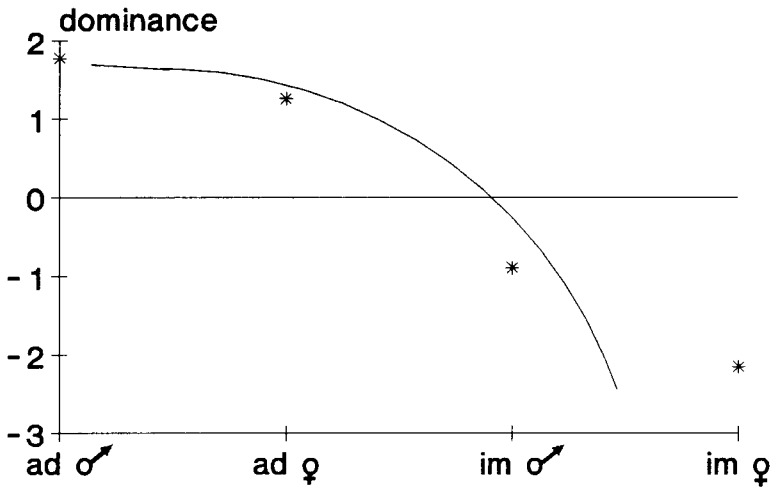

Fig. 2: Proposed model for dominance in the resident part of a Great Tit population in winter (cf. Fig. 8 in Gosler 1987). The values are the slope of lines derived from Tab. 1. (See text for further explanations.)

slope of the fitted lines (Table 1) can interpret as a measure of dominance, because it shows the changes of relative abundance of sex and age classes in more and more resident 'sub-populations'. Thus the winter dominance hierarchy in the resident part of this Great Tit population is as follows: adult males, adult females, immature males and immature females in descending order of dominance. Within age class the distance between sexes was smaller in the adults than in the immatures (Fig. 2).

4. Discussion

Many studies have investigated intraspecific dominance in tits (see Perrins 1979, Ekman 1989, Matthysen 1990). In these studies often only within age/sex class comparisons were made. The following main results have been obtained between groups: males are dominant over females in age class, and adults over juveniles in sex class. Similar results have been shown for other passerine species, as well (e.g., Enoksson 1988, Cristol et al. 1990, Senar et al. 1990). Within age/sex classes resident individuals are dominant over floaters (Drent 1987, Nilsson & Smith 1988, Desrochers & Hannon 1989, Nilsson 1989, Sandell & Smith 1991). However, there remain uncertainties, for instance the relationship between adult females and immature males. Kluyver (1957) pointed out that adult females are dominant over immature males in the Great Tit, which is supported by this study, but other studies did not strengthen this result (Saitou 1979, Drent 1983, Gosler 1987). When residency is also taken into account the relationships became less clear (e. g., who is dominant, a resident immature female, or a non-resident adult male). Sandell & Smith (1991) studied this problem on male Great Tits in aviary experiments. They found that prior residency determined dominance in age class, but when resident juvenile birds were interacting with late established

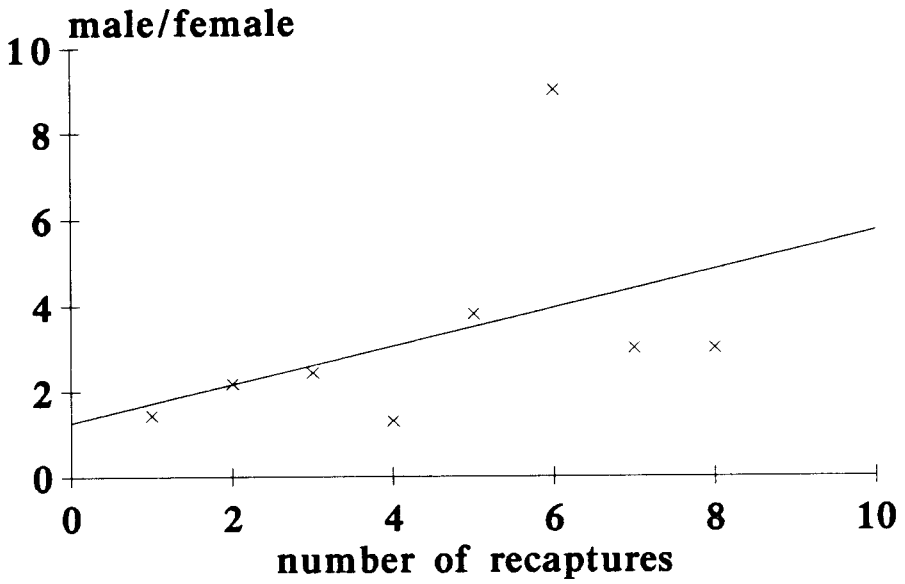

Fig. 3: The changes of male/female ratio in the resident part of a Great Tit population. The fitted line suggests that the proportion of females decreasing, as we sampled more and more resident sub-populations.

adults, the formers often became dominant. However, only experiments can provide such 'simple' cases, in the field, where the whole range of residency, age and sex are acting in determining dominance, the situation seems to be more confused.

The results of our study seem to be in contradiction with findings of Gosler (1987). He proposed a model relating feeding niche and morphology to dominance. His model explained the variation in bill-index between tit classes, and other morphological variations, as well. However, his dominance order was: adult male, immature male, adult female and immature female, in decreasing order of dominance (Gosler 1987), as has been reported by Drent (1983) for this species, whilst this seems to be contradictory with our results. However, in Gosler's study the winter samples were taken from the whole population, not only from the resident part. Therefore we may suppose that if we did not distinguish between the resident and non-resident part of the population, we might get similar results. The deviation between our results and those of Gosler's (1987) may reflect the importance of considering residency as a crucial factor in winter dominance. To justify our hypothesis on the differences between this study and that of Gosler's (1987) we try to analyse those data, which were collected at the bird feeders near to the nestbox area. Nevertheless, there were not enough recaptures to do the same analyses as in the case of roosting tits. In fact, the feeders were 300 m apart from the nestbox area, therefore resident tits were usually recorded in the nestboxes as well, so after separation of roosting and 'feeding' (recorded only at feeders) tits, no birds occurred who were resident in winter, but did not roost in the nest-

boxes. This result shows that the artificial feeding, which has been reported as crucial factor in winter survival of North-European Great Tit populations (see Orell 1989) is not as significant in this Central-European population.

There is an alternative hypothesis to explain the differences in dominance relationships between Gosler's and this populations. Ekman (1990) found that dominant male Willow Tits (*P. montanus*) provide their mates with protection in winter, therefore these females survived better than low-ranked males even though they were subordinate in direct interactions. May be a similar situation exist in this Central-European Great Tit population, because there is a tendency to be paired in winter, as the mates use nestboxes to roost in near proximity (Báldi pers. obs.). Therefore we can assume that the increasing relative abundance of adult females is a consequence of providing roosting sites to their mates by the adult males. Hence a similar correlation between partners, as described by Ekman (1990) could lead to age appearing more important than sex as a determinant of social status.

It has been recognised that mortality of females is greater than that of males in the Great Tit (Bulmer & Perrins 1973, Orell & Ojanen 1979), but this greater mortality was attributed to predation and breeding trials in the breeding season (Bulmer & Perrins 1973). However, our results suggest that mortality of females may be greater in the non-breeding season also, at least in the resident part of the population, because the ratio of males to females increased as residency increased (Fig. 3). We assumed that mainly the mortality is responsible for the disappearance of tits for two reasons. First, we studied the resident part of the population, where the proportion of recaptures was very high (see results). Second, the study area has been a forest patch, that is a habitat-island, where the dispersion may be smaller than in a continuous large forest.

Acknowledgements. We are indebted to J. Ekman, A. Gosler, T. Székely and J. Török for their valuable comments on the manuscript. We thank J. Báldi and G. Miklai for assistance in the fieldwork. The study was supported by a grant to A. B. from the Foundation for the Hungarian Sciences.

Összefoglalás

Dominancia-viszonyok egy téli széncinege (Parus major) populációban

Az ócsai égerlápon 1986 és 1990 között vizsgálatokat végeztünk telelő széncinegéken. A terepmunka során kéthetente sötétedés után a mesterséges fészekodúkban éjszakázó cinegéket regisztráltuk. Alapfeltevésünk szerint a fészekodúk az erőforrások lényeges részét képezik, mert védelmet nyújtanak a ragadozók és az időjárási viszontagságok ellen. Dominánsnak azt az ivar illetve korcsoportot tartjuk, amelyik relatív gyakorisága nő a tél folyamán az odúkban, hiszen a dominancia az erőforrásokból történő részesedésen alapul. Az így kapott dominancia sorrend: öreg hím, öreg tojó, fiatal hím és fiatal tojó, csökkenő sorrendben. Ez több eddigi eredménytől eltérő, ennek lehetséges okait tárgyaljuk.

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Received 10 January 1993, revised 20 March 1993, accepted 15 June 1993